

## **Upper-Ocean Heat Balance Processes and the Walker Circulation in CMIP5 Model Projections**

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Considerable uncertainty remains as to the importance of mechanisms governing decadal and longer variability of the Walker Circulation, its connection to the tropical climate system, and prospects for tropical climate change in the face of anthropogenic forcing. Most contemporary climate models suggest that in response to elevated CO<sub>2</sub> and a warmer but more stratified atmosphere, the required upward mass flux in tropical convection will diminish along with the Walker component of the tropical mean circulation as well. Alternatively, there is also evidence to suggest that the shoaling and increased vertical stratification of the thermocline in the eastern Pacific will enable a muted SST increase there-- preserving or even enhancing some of the dynamical forcing for the Walker cell flow.

Over the past decade there have been observational indications of an acceleration in near-surface easterlies, a strengthened Pacific zonal SST gradient, and globally-teleconnected dislocations in precipitation. But is this evidence in support of an “ocean dynamical thermostat process” posited to accompany anthropogenic forcing, or just residual decadal fluctuations associated with variations in warm and cold ENSO events and other stochastic forcing? From a modeling perspective we try to make headway on this question by examining zonal variations in surface energy fluxes and dynamics governing tropical upper ocean heat content evolution in the WCRP CMIP5 model projections. There is some diversity among model simulations; for example, the CCSM4 indicates net ocean warming over the IndoPacific region while the CSIRO model concentrates separate warming responses over the central Pacific and Indian Ocean regions. The models, as with observations, demonstrate strong local coupling between variations in column water vapor, downward surface longwave radiation and SST; but the spatial patterns of changes in the sign of this relationship differ among models and, for models as a whole, with observations. Our analysis focuses initially on probing the inter-model differences in energy fluxes / transports and Walker Circulation response to forcing. We then attempt to identify statistically the El Nino- / La Nina-related ocean heat content variability unique to each model and regress out the associated energy flux, ocean heat transport and Walker response on these shorter time scales for comparison to that of the anthropogenic signals.